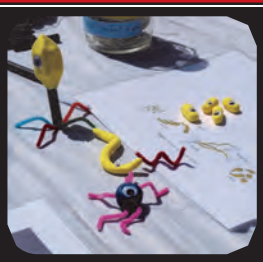
The Lipman Log

2015

B. Goodman, T. Barkay, M. Häggblom



Marvelous microbes

Barkay Lab

J. Hunter-Cevera, D. Eveleigh

Rutgers Day

News from the Chair, Max Häggblom

Greetings from Lipman Hall! This issue of the Lipman Log includes some of the highlights from the 2014-2015 academic year. We hope you will enjoy reading about the various activities and accomplishments of our students and faculty, and the awards that they have received.

It is our distinct pleasure to congratulate Dr. Ning Zhang on her promotion to Associate Professor with tenure. You can read about her exciting research program in elucidating the evolution, phylogenomics and systematics of fungi on page 3. She also received the Board of Trustees Research Fellowship for Scholarly Excellence for 2015 as one of Rutgers University's distinguished young faculty members. Furthermore, Ning was recently awarded an NSF Career Grant "An online global monograph of Magnaporthales - evolution, taxonomy, biogeography and biology of the rice blast fungus and allies".

We are delighted to congratulate Dr. Tamar Barkay on her promotion to Distinguished Professor, and on her receipt of the Board of Trustees Award for Excellence in Research. Over her career Prof. Barkay has pioneered innovative methodology in the field of microbial ecology, specifically in how microbial activities affect the environmental fate of inorganic contaminants. She has made seminal, internationally recognized contributions in elucidating the microbial processes that impact the geochemical cycling of mercury in the environment. Dr. Barkay's research on mercury has had major impact on the field on environmental microbiology and she is considered one of the most knowledgeable microbiologists in the world on the topic of mercury environmental biogeochemistry. Read more about Tamar's research on page 4.

Our annual Microbiology Symposium (page 2) continues to bring faculty and students from across Rutgers together to hear about the most recent advances in microbiology research. The symposium includes a keynote speaker (one of our alumni), short talks by current faculty and poster presentations by our graduate and undergraduate students and postdocs.

Rutgers Day—AgField Day is always a fun event and a great opportunity to meet alumni and friends. "*Boisterous Biochemistry and Marvelous Microbiology*" is our program theme. As in previous years, members of the G.H. Cook Biochemistry and Microbiology Undergraduate Student Club and the ASM Student Chapter, and other graduate students of the department coached budding scientists in the wonders of biochemistry and microbiology, this time with a new "*Cheese or Feet?*" activity (see page 9).

We continuously work on updating our biochemistry and microbiology laboratory courses and introducing new experiments and lab modules. On page 6 we highlight the exciting recent development with the use of electronic notebooks in the microbiology teaching laboratory.

Our scholarly and undergraduate and graduate programs in biochemistry and microbiology continue to flourish, and it is always a delight to follow the achievements of our students. Our graduate and undergraduate students are engaged in many exciting research projects with our faculty members. In this issue you can read more on the latest Ph.D. and M.S. theses, the awards our students have received and about their other activities.

To support our next generation of graduate students we have established the Cuskey and Eveleigh Graduate Student Travel Awards, which are already providing much needed support for our students to travel to national and international conferences to present their work, network, and learn. Since announcing our fundraising campaign in 2014 we have made quite good headway. Many of our alumni and friends have come forward to contribute, and we are delighted to report that we now have donations and pledges to fully endow the Douglas E. Eveleigh Graduate Student Travel Award. Thank you!!! Our next "target" is to fully endow the Douglas E. Eveleigh Graduate Fellowship to support incoming students in the Microbial Biology Graduate Program. Together with the Woodruff and Macmillan Graduate Fellowships the Microbial Biology Graduate Program will be on a solid foundation.

I wish to thank all our donors. Your generous donations provide important student scholarships, awards and travel fellowships and support our Fermentation Club seminar series. We hope that you will continue to show your support for the department and our scholarly programs in the future. Please see the back page on how you can contribute.

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Microbiology at Rutgers University: 2015 Symposium

Cultivating Traditions, Current Strength, and Future Frontiers

Eric W. Triplett, Keynote Speaker

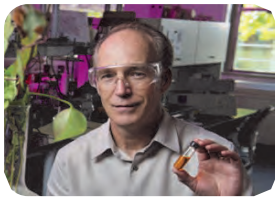
Peter Oudemans

Eddy Arnold

Eric Klein

Xilin Zhao

Ning Zhang



Charles Dismukes

Max Häggblom

Sarah Campbell

Donato Giovannelli

Thursday, January 29th

Welcome: Robert Goodman, Executive Dean of the School of Environmental and Biological Sciences
History: Peter Oudemans, Plant Biology & Pathology "Keeping New Jersey plants healthy since the 1880s"

Keynote presentation: **Eric W. Triplett** Professor and Chair, Dept. of Microbiology and Cell Science – University of Florida. Dr. Triplett earned a B.S. in 1976 from Rutgers University, Cook College, and his Ph.D. from the University of Missouri, Columbia.

"Separating signal from noise in the gut microbiome - Type 1 diabetes as a case study"

Human microbiome data, whether it be 16S rRNA, metagenomic transcriptomic, etc., is often very noisy. So noisy that It is often very hard to decipher connections between disease and the microbiome. After a few years of effort studying the role of the microbiome in the development of autoimmunity for type 1 diabetes, we have learned that much of the noise is related to the original cohort design and that the analysis should consider the events that lead to disease onset. These considerations have led to what we believe are meaningful connections between the microbiome and disease that can be further tested in a variety of ways. Suggestions for future cohort designs will be described that can reduce the environmental confounders of microbiome composition. In addition, we are beginning to study the methylome of the microbiome and propose that the epigenome be examined along with other 'omics' analysis.

Poster Session combined with a Wine and Cheese Reception

Friday, January 30th:

Session I: Convener: Ning Zhang
9:00 **Eddy Arnold**: "Structure and function of HIV-1 reverse transcriptase: Implications for drug design and resistance"
9:30 **Eric Klein**: "Type-1 pili mediate adhesion-based signaling in uropathogenic *E. coli*"
10:00 **Xilin Zhao**: "Stress-mediated bacterial program cell death"

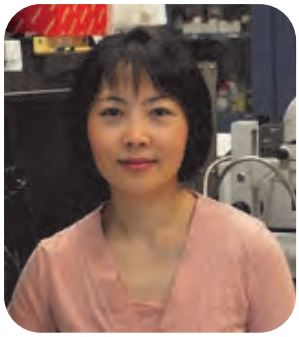
Session II: Convener: Tamar Barkay
11:00 **Ning Zhang**: "Anything but barren: Fungal biodiversity in the Pine Barrens"
11:30 **Charles Dismukes**: "Search for photosynthetic microbial weirdophiles—the path to microalgal production strain for biofuels"
12:00 **Max Häggblom**: "Anaerobic bacteria with the unusual appetite for MTBE"

12:30 – 2:00 Lunch and Poster Session

Session III: Convener: Costantino Vetriani
2:00 **Sara Campbell**: "Exercise as a lens to view the microbiome and intestinal health"
3:00 **Donato Giovannelli**: "Insight into the evolution of carbon fixation revealed by comparative genomic analysis of the anaerobic chemosynthetic bacterium *Thermovibrio ammonificans*"

3:30-4:30 pm Poster Session

Ning Zhang — Evolution, Phylogenomics, and Systematics of Fungi



Ning Zhang joined Rutgers in 2009 with a joint appointment in the Departments of Plant Biology and Biochemistry & Microbiology. She was promoted to Associate Professor and received the Board of Trustees Research Fellowship for Scholarly Excellence in 2015. In the past six years she has published 30 peer-reviewed papers and three book chapters. For more information go to: http://plantbiopath.rutgers.edu/faculty/zhang/zhang.htm

Dr. Zhang is a fungal biologist studying various groups of Fungi, the second largest kingdom of eukaryotic life. An estimated 1.5 million species of Fungi comprise a diverse group of organisms that have vital functions as decomposers, pathogens, and as components of other symbioses in biomes, but after two centuries of active study, only about 10 % of these prognosticated fungal species have been discovered by scientists. Plant-fungus symbiotic associations are very common but many plant associated fungal communities have not been sampled. Huge gaps persist in our understanding of fungal biodiversity, evolution and function. Her long-term goal is to contribute to resolving vital principles for the study of evolution, biodiversity and functions of Fungi, especially those that are associated with grasses. She has three primary research interests that are intrinsically linked to each other:

1. Fungal systematics, evolution and genomics: Since she joined Rutgers in 2009, Ning has focused on the study of grass (*Poaceae*) associated fungi. For the systematics research area, she has been working on the Magnaporthales, an order in Ascomycota that contains saprobes, endophytes as well as important plant pathogens, such as the rice blast fungus, take-all pathogen of cereals, and the summer patch pathogen of turfgrasses.

Rice contributes 23% of the total calories consumed by the human population. The blast fungus *Pyricularia oryzae* (= *Magnaporthe oryzae*) is one of the most devastating pathogens threatening global food security, and reducing rice yields by as much as 75% in infected areas. Supported by an NSF grant "Systematics of Magnaporthaceae: Understanding Evolution of the Rice Blast Fungus and Allied Species Using Phylogenetic, Phylogenomic and Comparative Genome Analysis" (Co-PI Debashish Bhattacharya) and a Rutgers Faculty Research Grant, her group completed genome sequencing for five species and transcriptome sequencing for 21 species in Magnaporthales, which covered all major lineages in the Magnaporthales, including pathogens, non-pathogens, aquatic and terrestrial species. Phylogenomic analysis suggested a set of relationships that differs significantly from traditional classification schemes. Her results indicate that ecological and pathogenic features are more informative than morphology in defining monophyletic clades among these taxa. Her group discovered that the rice blast fungus, which has both root and aerial infection capacity is in an early diverging clade, and that the more specialized root-infecting species were derived and lost their aerial infection ability. This hypothesis is supported by the genome sequence data and this study has been published in Mycologia and Scientific Reports. In addition, she revised the generic concept and proposed two new genera, *Magnaporthiopsis* and *Pseudophialophora*, which were collected from native grass roots in the New Jersey Pine Barrens.

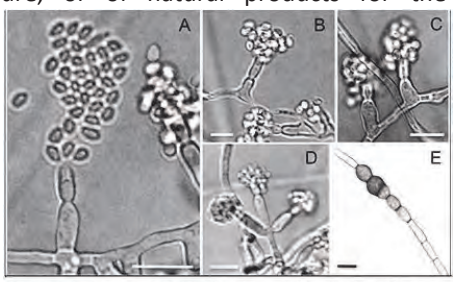
Data from this research are complementary and compatible with the "**Assembling the Fungal Tree of Life**" and the "**1000 Fungal Genomes"** projects, and will assist studies worldwide in various areas related to fungal biology and pathogenesis.

As part of the NSF project, she will host a symposium and workshop at Rutgers University in January 2016 in order to disseminate knowledge and increase the understanding of fungal genomics. This program will be attended by researchers from around the world and will enhance Rutgers' reputation for excellence in fungal biology and genomics.

Regarding the nomenclature and taxonomy of the rice blast fungus, the website http://magnaporthe.blogspot.com that she developed for communication on the nomenclature of Magnaporthe has had over 20,000 pageviews from 30 countries.

Recently she was awarded an **NSF CAREER** grant, which will further support the study on Magnaporthales: "An online global monograph of Magnaporthales - evolution, taxonomy, biogeography and biology of the rice blast fungus and allies"

2. Fungal biodiversity and functions in the ecosystems: Most of fungal biodiversity on Earth remains unknown, especially in unexplored habitats. In the past three years, her lab has been sampling Poaceae grass roots from the New Jersey Pine Barrens and the tropical rain forests of Yunnan, China. The Pine Barrens is a unique, unexplored ecosystem that is dry, acidic and nutrient-poor, where switchgrass and other stress tolerant species are dominant understory plants. Such drought and low nutrient stress typified early terrestrial environments when plant colonization of land occurred and was facilitated by root-symbiotic fungi. Her results indicate that grass roots in Pine Barrens are one of the major reservoirs of novel fungi almost half of which are undescribed species that could be new sources of useful endophytes for agriculture, or of natural products for the pharmaceutical industry.



Acidomelania panicicola Walsh & Zhang, *Mycologia* 2014. New fungal genus and species discovered from native switchgrass root in New Jersey Pine Barrens

Importantly, her group also observed that *Acidomelania panicicola*, a new genus and species that they were the first to describe from a switchgrass in the Pine Barrens, significantly increases root hair growth of switchgrass, rice and lettuce plants in low nutrient conditions. This fungus may have practical agricultural applications allowing crops to be transplanted more successfully, and perhaps grow without high levels of fertilizers. Given these observations, Ning is working towards a holistic understanding of fungal biodiversity by studying the phylogenetics, taxonomy, genetics and functions of fungi associated with grass roots. This work will fill in missing branches in the tree of fungal biodiversity and provide a robust taxonomic framework to incorporate these novel lineages. Her group is also working on elucidating how these fungi promote plant productivity, which is important for both natural and crop-associated applications. In collaboration with researchers at Rutgers and beyond, her lab has been conducting biodiversity, ecology and functional studies for fungi associated with turfgrass, hazelnut, maize and other plants in the past five years.

3. Development of novel molecular methods for detection of pathogenic fungi: New pathogens are emerging all the time and many known pathogens are evolving fast due to dramatic climate change, host switching, and frequent transportation by humans creating a crisis in agricultural biosecurity. Ning has been developing new tools for rapid pathogen detection and identification. The Oligonucleotide Array method offers a fast, high-throughput alternative for the detection of microbes from virtually any sample. The Oligonucleotide Array has been applied to medical and food microbe detection but it is relatively new in the Plant Pathology field. Most published arrays are for detection of bacteria and viruses and very few have been developed for fungal pathogens. It is both an opportunity and a challenge to develop arrays for fungal plant pathogen detection. Her lab is currently developing a Turf PathoCHIP (array based method) and real-time PCR for turfgrass and other plant pathogens.

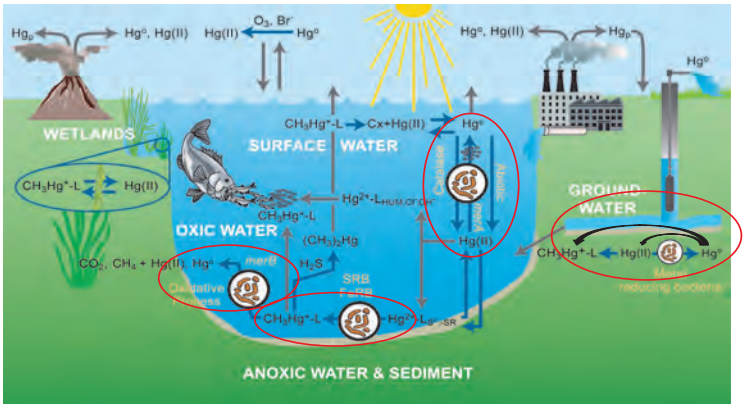
Tamar Barkay — Microbial Transformation of Mercury in the Environment

Tamar Barkay, a Distinguished Professor in the Department of Biochemistry and Microbiology at the School of Biological and Environmental Sciences (SEBS), is an international authority on environmental mercury cycling. Her research examines the role of microbes in mercury poisoning and unlocks gates to understanding of this complex environmental problem.

Tamar Barkay pictured sampling in Alaska (2014)

Mercury (Hg) is a priority environmental pollutant which, in its methylated form, is a major health hazard, especially so as it is bioaccumulated and biomagnified through aquatic food webs. Human activities associated with industrialization have exacerbated Hg contamination, leading to Hg levels in fish and other aquatic animals that exceed guidelines for human consumption. Mercury toxicity and bioaccumulation depend on the microbially mediated synthesis of neurotoxic methylmercury, occurring mostly in anoxic environments such as marshes and lake sediments. Scientists from the Dept. of Biochemistry and Microbiology at SEBS at Rutgers have been central to mercury biogeochemistry research for over 30 years and have made seminal contributions to this field. Studies initiated in the 1980's by Prof. Richard Bartha were motivated by the severity of mercury contamination in New Jersey. Throughout the 1980's and 1990's Dr. Bartha's teamed with Prof. Theodore Chase from the department to make paradigm changing discoveries by showing that microbes that live by breathing sulfate are the principle mercury methylators in anoxic sediments. They proceeded to discover a biochemical process that lead to the formation of methylmercury. Professor Barkay's research has sustained and expanded Rutgers' strong standing in Hg research by studying Hg methylation and other processes that affect methylmercury formation and degradation.

Tamar joined the department in 1999, following Dr. Bartha's retirement, to continue the mercury biogeochemistry studies that she had previously developed as a researcher at the Environmental Protection Agency. By combining molecular biological and biochemical approaches, her team has made major discoveries that have shaped our current view on the fate and effects of Hg in the environment. With her students she discovered that the accumulation of methylmercury in the environment is limited by microbes that degrade this neurotoxic substance. Her discovery provided an explanation to the "mercury accumulation paradox" whereby methylmercury accumulation in highly contaminated environments, such as Berry's Creek in the Meadowlands of New Jersey, is relatively low compared with accumulation in environments with low levels of contamination, such as Pinelands lakes. Other important contributions made by Dr. Barkay include the development of luminescence bioreporter microbes that indicate the concentrations of mercury that are bioavailable for methylation. In co-operation with biogeochemists and geo-microbiologists from all over the world, including Canada, Denmark, Slovenia, France, Brazil, and Japan; Dr. Barkay has used her bioreporters to define factors that control mercury speciation and availability to methylating microbes in diverse environments. She has shown how deep-sea microbes in hydrothermal vents and those from hot springs in Yellowstone National Park are highly adapted to the high concentrations of Hg from geological sources in the depth of the Earth's subsurface. Furthermore, Dr. Barkay has discovered that the early evolution of Hg resistance among microorganisms likely occurred among thermophilic microbes in these geothermal environments. In contrast, she also showed how even in one of the coldest places on Earth, northeast Greenland, microorganisms in the ice and snow of the high Arctic actively transform mercury between its various chemical forms. These results provide one explanation to observed patterns of methylmercury accumulation in Arctic food chains. On-going research in Dr. Barkay's lab is currently examines the impact of global climate change on the dynamics of methylmercury formation and degradation in Alaskan wetlands.

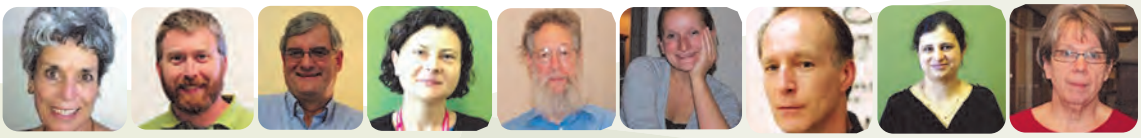


The Hg biogeochemical cycle. Processes that are addressed by current projects in her lab are circulated in red.

Through many years of active research on the microbiology of the mercury geochemical cycle, Dr. Barkay has gained the respect of the international Hg biogeochemistry community. Her standing within this community is highlighted by frequently requested review and opinion articles commenting on new developments in this field and by her service on advisory boards and as an organizer of conference sessions that are dedicated to the microbiology of mercury biogeochemistry.

Congratulations to **Professor Tamar Barkay** (pictured left) on her receipt of the Board of Trustees Award for Excellence in Research. Dr. Barkay was recognized for the study of microbial transformation of mercury in the environment, which benefits environmental microbiology and microbial ecology. Dr. Barkay was promoted to Distinguished Professor in July 2015.

Our Faculty



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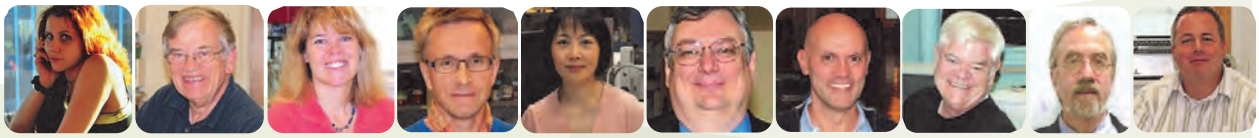
Our Faculty



Awards/Grants/Activities

Tamar Barkay: The National Science Foundation Office of Polar Programs-funded project examining how methylation of mercury is affected by global warming induced changes to wetlands in Alaska is in progress. In July 2014, Tamar joined a group of collaborators for two weeks of sampling wetlands in Alaska bringing back hundreds of frozen samples for molecular analyses. These are analyzed for community structure and presence and diversity of mercury transforming genes and their transcripts. The results are integrated with collaborators' biogeochemical findings to reveal how pathways for mercury transformations and methylmercury accumulation are impacted by global climate change.

GC Dismukes (PI), P. Subramanian (coPI) **BASF-Chemical**, Analytical Division, Iselin, NJ. "EPR of metal doped molecular sieves" July 1, 2014 – June 2015; $69.665.

GC Dismukes (PI) M. Greenblatt and R. Garfunkel (co PIs) **NSF-CBET** "Tunable Photoanode-Photocathode-Catalyst-Interface Systems for Efficient Solar Water Splitting"; $799,496.

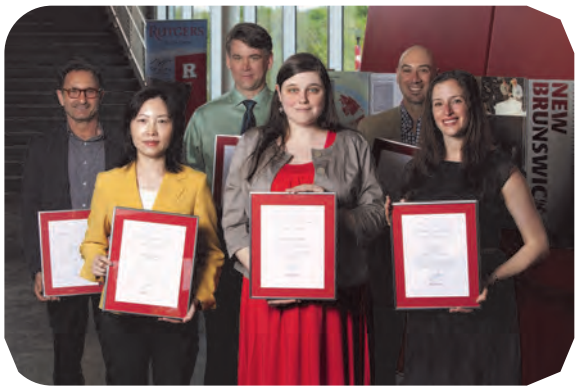
K. Ayers (PI) at Proton OnSite; coPI: GC Dismukes: DOE-EERE-SBIR "Benchmarking of Transition Metal Oxides and Phosphides as Electrocatalysts for Renewable Hydrogen Production from Water"**;** $50,000 (sub-contract).

GC Dismukes: NSF-MCB "Computational and Experimental Systems Biology of Cyanobacterial Metabolism" with Desmond Lun (PI); 2015-2018. $700,000.

Max Häggblom: The Hudson River Foundation is funding a 2-year project to study the fate and ecotoxicity of pharmaceuticals and personal care products, emerging contaminants in the Hudson River ecosystem. Co-PIs on the project are Keith Cooper, Lori White and Donna Fennell.

Yana Bromberg: The PhRMA Foundation has funded a new project to examine human genomic variation in disease ($100K).

Jeff Boyd: The Busch Biomedical Grant Program is finding a 2-year study on Environmental sensing and biofilm formation in *Staphylococcus aureus.* The objective of this project is to understand how *S. aureus* uses a unique iron-sulfur cluster regulatory system to sense the environment, alter attachment to surfaces, and commit to biofilm formation.



Congratulations to Dr. **Ning Zhang** (front row left) on her receipt of the Board of Trustees Research Fellowship for Scholarly Excellence as one of the university's distinguished young faculty members. Ning is with the Departments of Plant Biology and Biochemistry & Microbiology, School of Environmental and Biological studies. Ning was recognized for her research in mycology, including the evolution, phylogenomics, and systematics of fungi in Magnaporthales.

News from the Undergraduate Teaching Lab

Over the last year we have redesigned safety protocols for the microbiology teaching laboratories to match them with standards that have been set forth for research facilities. Due to the nature of experiments performed in our 400-level Applied Microbiology course, our microbiology teaching laboratory will be designated a Biosafety Level 2 laboratory. With this designation, papers or equipment should not leave the laboratory. In order to comply with these new challenges and to provide our students with the highest safety standards, we are providing portable iPads to every student for them to take notes, and to submit quizzes and post-lab reports. These iPads will also enhance student-centered instruction with inquiry based lab exercises; taking pictures of collected cultures; and performing Internet research for in-class assignments and group projects. The iMac Computer and Time Capsule will allow for proper data storage of the large volume of data that will be generated and provide an access point for the laboratory instructor and TA for grading.

This year **Dr. Ines Rauschenbach** (Teaching Instructor in Microbiology) received a grant from Instructional Computing for the purchase of 25 iPads to be used in the General and Applied Microbiology labs. The use of iPads was piloted during this summer's offering General Microbiology and students kept electronic laboratory notebooks. Currently, we are using the LabArchives classroom edition for maintaining laboratory notebooks. The LabArchives professional edition is used by The National Institutes of Health, many major universities across the country are using the professional or classroom edition, and currently we are the only group at Rutgers using the classroom edition of the LabArchives electronic notebooks in a teaching lab.

With electronic notebooks, no lab manuals, notebooks, pens, pencils, etc. come into the lab or return to the dormitory or home of the students. Students learn to work at Biosafety Level 2 and to better appreciate what is required, and why, to maintain this level of safety. Preparing our students for the increasing technical sophistication they will encounter in the workplace is a major challenge and requires that such state of the art equipment is available for use in the classroom. Learning to manage data using an electronic notebook gives our students an advantage as they move forward in their careers and electronic notebooks become the accepted norm. With LabArchives students can access their notebooks from home. While in class they keep notes, record necessary information, draw pictures of microscopic images, read the lab manual, take quizzes etc. all on their iPad. The iPad offers the opportunity to take pictures of data or experimental set-up and easily add them to the pages of their notebook. The iPads remain in the lab, being used by a new group of student in each laboratory section.

Summer session provides a great opportunity to introduce pilot programs as there are only two sections (this academic year there will be a total of 19 sections of General Microbiology Lab offered). The launch of electronic notebooks was well received by the teaching assistants and students alike. The TAs were able to easily grade the electronic submissions and supply feedback to the students. Students found that using the iPads and LabArchives was fairly easy to master. Although only 35% of the class enjoyed using the electronic notebook at the beginning of the summer, by the end of summer session 79% were enjoying the experience. The majority of students recognized that the use of electronic notebooks in class was an opportunity preparing them for their future in science.

Tong Liu, Environmental Sciences (Ph.D. 2014)
Advisor: Max Häggblom
Characterization of anaerobic methyl tert-butyl ether (MTBE)-degrading microbial communities

The wide use of methyl tert-butyl ether (MTBE), a synthetic fuel oxygenate, has caused extensive contamination in groundwater. MTBE can be degraded anaerobically, however assessment and enhancement of MTBE bioremediation requires knowledge of the microorganisms that are responsible for biodegradation. The aim of this study was to identify the organisms that mediate anaerobic biodegradation of MTBE in methanogenic or sulfidogenic cultures enriched from estuarine sediments. Stable isotope probing (SIP) combined with terminal restriction fragment length polymorphism (TRFLP) analysis showed that *Ruminococcaceae* species were active in the methanogenic MTBE-degrading community. TRFLP coupled with clone library analysis of bacterial 16S rRNA genes from sulfidogenic enrichment cultures showed that *Deltaproteobacteria* were highly enriched in a phylogenetically diverse community. We also investigated MTBE-degrading communities by single cell Raman Spectroscopy and SIP. This study provides crucial information for understanding the mechanisms of anaerobic degradation of MTBE as well as for assessment of the in situ bioremediation at contaminated field sites as the microbial/ molecular tools.

Tiffany Kung, Toxicology (Ph.D. 2014)
Advisor: Lori White
Persistent locomotor and behavioral effects resulting from developmental exposure to pyrethroid pesticide deltamethrin are mediated by dopaminergic and serotonergic system dysfunction

Pyrethroid pesticides are generally considered to be a safer alternative to other classes of insecticides. However, there is increasing concern that children are more susceptible to the adverse effects of pesticides. The hypothesis tested in this thesis is that exposure to pyrethroid pesticide deltamethrin, at concentrations below the LOAEL, during the critical developmental period would result in persistent behavioral deficits, which are due, in part, to changes in dopamine and serotonin system gene expression and neurochemistry. Zebrafish embryos were treated with deltamethrin during the embryonic period, and then reared in treatment free water until the larval and adult stages. This research demonstrated that environmental influences during critical neurodevelopmental stages results in persistent neurobehavioral deficits. Also, we add to zebrafish ethology using the experimental behavioral paradigms adapted for our laboratory. Finally, we provide a mode of action for deltamethrin induced behavioral deficits which can assist in the cumulative risk assessment of this class of compounds.

Shiming Tang, Microbial Biology (MS 2014)
Advisor: Gerben Zylstra
Molecular tools in environmental analysis

Culture independent molecular methods have been developed to analyze the taxonomy and function of uncultivated microbes in the environment. PCR-based sequencing and cloning, DGGE/TGGE, ARISA, TRFLP provide information for microbial ecology. Probe-based FISH tell about number and spatial information of target microbes. Metagenomics aims to analyze whole genomes of environmental microbes. mRNA tools such as RT-PCR, qRT-PCR, macroarray and some combination methods such as micro-FISH, SIP with metagenomics characterize the dynamics of microbial metabolism. This review compared different molecular tools in environmental analysis and their applications.

David Santos, Microbial Biology (MS 2015)
Advisor: Tamar Barkay
Zinc uptake and efflux mechanisms in bacteria

Transition metals play a critical role in biological systems, including respiration, zinc uptake and efflux as well as growth and reproduction. Transition metals are toxic at high concentrations and only required in trace amounts, while toxic metals must be immediately exported. Bacteria have evolved uptake and efflux systems to maintain this balance between toxic and replete concentrations of transition metals. This review highlights the zinc homeostatic systems used in the three domains of life with a focus on Zn uptake and efflux mechanisms in model organisms from each domain (*Saccharomyces cerevisiae*, *Escherichia coli* and *Ferroplasma* acidarmanus). Key differences such as structural features, regulatory mechanisms for specific Zn uptake and efflux were compared.

Lei Shan, Microbial Biology (MS 2015)
Advisor: Don Schaffner
Statistical distributions describing microbial quality of fresh produce in food service facilities

Catherine L. Perry, Microbial Biology (MS 2015)
Advisor: Karl Matthews
Current trends in probiotic beverages and their applications in global health problems

Probiotics have been used to restore and enhance gastrointestinal health for decades. Lactic acid bacteria are among the most widely used probiotic microorganisms. Supplements and dairy products, such as yogurt, kefir and fermented milk are the primary source of commercially available products, but these are not appropriate for all consumers. Novel food technologies such as microencapsulation and its applications for inoculating beverages with live cultures of probiotic microorganisms are investigated. This review focused on the advances in non-dairy probiotics, probiotic beverages, technologies in beverage formulation, and the use of novel probiotics.

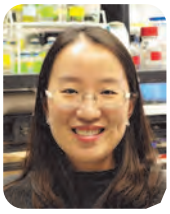
Aubrey Miles Watson, Microbial Biology (MS 2015)
Advisor: Siobain Duffy
Assessing life history tradeoffs in host range mutants of RNA bacteriophage phi6

Kennida Polanco, Microbial Biology (MS 2015)
Advisor: Max Häggblom
Microbial degradation of three novel bisphenol compounds

Bisphenol A (BPA) is a synthetic compound used in the production of polycarbonate, epoxy resins and in the synthesis of the flame retardant tertrabromobisphenol A. Its endocrine disrupting properties in animals, as well as its persistence in anaerobic environments has motivated a search for alternative compounds to substitute BPA in the production of food and water containers. The objective of this study was to evaluate the potential for biodegradation of three novel bisphenol analogs [2-6'-dimethyl, 4-4'-dimethoxy bisphenol; 1-1'-ethyl, 2-6-dimethyl, 4-4-dimethoxy bisphenol; and 1-1'-propyl, 2-6-dimethyl, 4-4-dimethoxy bisphenol] with chemical proprieties that made them suitable for substituting BPA. Enrichment cultures using Arthur Kill sediments as inoculum were set under aerobic and anaerobic conditions. These data suggest that the new bisphenol analogs are biodegradable under anoxic and oxic conditions where BPA is recalcitrant .

Our Graduate Students

Ph.D. Theses / Masters Theses



Seoyean Sohn, Environmental Science (Ph.D. 2015)
Advisor: Max Häggblom
Microbial reductive dehalogenation of persistent halogenated aromatic contaminants in sediments of the Hackensack River in New Jersey

Microbial reductive dechlorination of problematic halogenated aromatics was observed in aquatic sediments. Laboratory experiments demonstrated reductive dehalogenation of hexachlorobenzene (HCB) and pentachloroaniline (PCA) in anaerobic microcosms set up with sediment samples originating from different sites along the Hackensack River, NJ. Carbon compound specific isotope analysis (CSIA) was conducted to obtain isotope fractionation data for dehalogenation. *Chloroflexi* specific 16S rRNA gene PCR-DGGE followed by sequence analysis detected members of the "Pinellas subgroup" of *Dehalococcoides mccartyi* in sediment. From this study, we conclude that indigenous anaerobic microorganisms in the Hackensack River, NJ are capable of dehalogenating chloro- and bromobenzenes. Molecular community analyses demonstrated that there are different responsible microbial communities corresponding to the locations of the Hackensack River. A "priming" effect of HCB on hexabromobenzene dehalogenation was observed. CSIA data for highly halogenated benzenes suggest that it may have application for assessing in situ microbial reductive dehalogenation.

Isabel Gray, Environmental Sciences (Ph.D. 2015)
Advisor: Max Haggblom
Sponge-associated dehalogenating microorganisms and isotope analysis of their dehalogenation of brominated phenols

Biogenic organohalides appear to enrich for a population of dehalogenating microorganisms within sponges. The anaerobic dehalogenating bacterium *Desulfoluna spongiiphila* was previously isolated from the marine sponge *Aplysina aerophoba* collected from the Mediterranean Sea. We sought to determine whether bacteria capable of reductive dehalogenation are associated with other sponge species from different locations, including the Mediterranean and temperate and tropical oceans. Anaerobic enrichment cultures prepared from marine sponges were amended with 2,6-dibromophenol as electron acceptor and short chain organic acids as electron donor. Cultures that showed dehalogenation were maintained and the dehalogenating microorganisms further enriched by successive transfers. Our data demonstrate that *D. spongiiphila* and its close relatives can be found in debrominating enrichment cultures from over 20 marine sponge species from the Atlantic and Pacific Oceans and the Caribbean and Mediterranean Seas. The dehalogenating strains isolated to date are closely related to *D. spongiiphila* and *Desulfoluna butyratoxidans*, suggesting a cosmopolitan association between *Desulfoluna* spp. and various marine sponges. These dehalogenating bacteria may form stable populations within the sponge animal that function in the cycling of organohalide compounds.

Our Alumni

Jennie Hunter-Cevera (Ph.D. '78) was honored on April 26, 2015 with the Dennis M. Fenton Distinguished Graduate Alumni Award from the George H. Cook Community Alumni Association. Dr. Hunter-Cevera earned her Ph.D. in microbiology in 1978 working with Prof. Doug Eveleigh. She has a distinguished career in industry, government and academia, with 25 years of experience in the pharmaceutical and biotechnology industries. She is currently Acting Secretary of the Maryland Higher Education Commission and serves on the Rutgers School of Agriculture and Environmental Science Advisory Council.

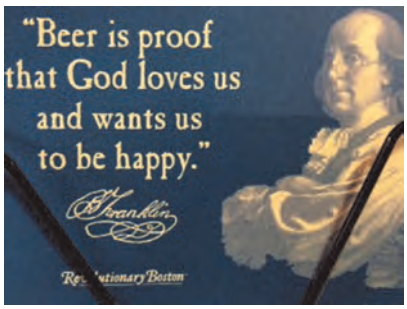
On May 8, 2015, **Andy Marinucci** (Ph.D. 81; working with Richard Bartha) was recognized by the Theobald Smith Society (NJ Chapter of the American Society for Microbiology) with the "Distinguished Service Award" for outstanding and enduring service to the TSS in the promotion of microbiology.

Steve Picataggio (Ph. D. 1993) at DuPont Co., Wilmington, was elected to the board of the Society for Industrial Microbiology and Biotechnology.

Tom Jeffries received the Society for Industrial Microbiology and Biotechnology Charles Porter Award at the annual meeting in Philadelphia. This highly prestigious award recognizes continued outstanding service to the Society. Tom gained his Ph.D. with Jim Macmillan in 1975. Tom served worked for 32 years at the USDA Forest Products Laboratory, Madison WI, serving as Director of Microbial and Biotechnology (1998-2004). He received the Forest Service Award for Technology, 2006. Retiring from the USDA, 2012 he founded his own company Xylome Corporation. He is a past President of SIMB.

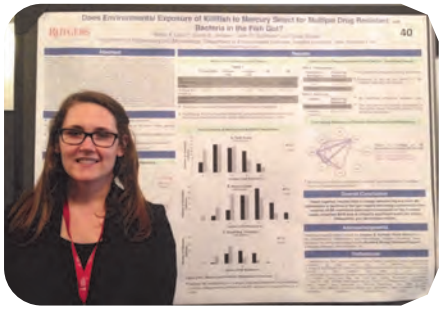
President Tim Davies presenting the Charles Porter Award to Tom Jeffries (SIMB, 2015)

Doug Eveleigh gave the banquet speech at the Society for Industrial Microbiology and Biotechnology annual meeting "Benjamin Franklin - Microbiologist?"



Our Graduate Students

Ananya Agarwal, Hang Dam, Zuelay Rosario Cruz, Preshita Fatima Foflonker, Gadkari, Jie Liu, Tiffany Louie, Nicole Lloyd and Javiera Norambuena (Microbial Biology Ph.D. students) were awarded $500 travel awards from the Microbial Biology Graduate Program to attend scientific meetings this summer.



Nicole Lloyd (Barkay Lab)

Nicole Lloyd was the recipient of the Douglas E. Eveleigh travel grant. She used her award to travel to the 4th ASM Conference on Antimicrobial Resistance in Zoonotic Bacteria and Foodborne Pathogens in Washington, DC; presenting her work in a poster titled, "Does environmental exposure of killifish to mercury select for multiple drug resistant bacteria in the fish gut?"

Ashley Grosche (Vetriani Lab) was the recipient of the Robert S. and Eileen A. Robison Scholarship Award for Excellence in Graduate Studies for 2014. Congratulations!! The Award was established in 2003 and is supported by the Robison family. The scholarship is awarded to a graduate student who has demonstrated competence and accomplishment in their academic and research program while at Rutgers University, has shown an active participation in or a leadership role in the activities of the department, college, university or community, and is motivated to help and improve the human condition at this time and upon graduation.

Tiffany Louie (Häggblom Lab) received the Douglas E. Eveleigh Travel Award to present her work at the 2015 Society for Industrial Microbiology and Biotechnology annual meeting in Philadelphia. She received the Carol D. Litchfield Best Student Poster Presentation award in the "environmental" category for her poster "A preliminary glimpse into the genomes of *Sedimenticola selenatirereducens* AK4OH1".

Preshita Gadkari and Hang Dam received Stephen M. Cuskey Travel Awards and **Jie Liu** received a Douglas E. Eveleigh Travel Award to attend and present their work at the 2015 Gordon Research Conference on Applied and Environmental Microbiology.

Zuelay Rosario-Cruz was awarded Conference Travel Awards from the Microbial Biology Program and the Rutgers Graduate School of New Brunswick to present a poster titled "Copper Homeostasis in *Staphylococcus aureus*" at the 2015 General Meeting of the American Society of Microbiologists held in New Orleans, LA.

Preshita Gadkari (Häggblom Lab) completed 26.2 miles in pouring rain and headwind on April 20th in the **119th Boston Marathon**.

#bostonstrong - made us all proud.

Rutgers Day (April 2015) : This was truly a microbial field day! The student chapter hosted activities such as "cheese or feet", microscopy (led by Diane Davis) and sculpting giant microbes out of play-doh. Play-doh bacteria and phages with goog-ly eyes were made by enthusiastic, budding microbiologists.

In the "*Cheese or Feet?*" activity, socks with microbes that ran the 2015 Boston Marathon were blindly compared via olfactory senses to many stinky cheeses. Surprisingly, most participants agreed that the cheeses smelled worse than the socks or commented that the socks weren't smelly at all.

Congratulations to **Jennifer Goff,** Graduate Program in Microbial Biology. The Microbial Biology Academic Standing Committee nominated Jennifer for the Hachnasarian Scholarship Award. This is a $1,000 fellowship awarded through the SEBS Dean's office. The Committee basis its selection on Comprehensive Exam scores, first year course grades, and lab rotation performance. Past Hachnasarian awardees are Ameya Mashruwala, Zuelay Rosario Cruz, Jessica Choi and Javiera Norambuena.

Our Graduate Students— ASM Student Chapter

Michael Bamimore received the Best Poster Award for his presentation at the Rutgers Microbiology Symposium this past January for his poster on, "Physiological properties and synthesis of the *Caulobacter crenscentus* stalk." Michael is a student in **Eric Klein's Lab**, Biology Department at Rutgers Camden. He was recently featured in Rutgers Camden student spotlight!

M. Bamimore and A. Mashruwala

Ameya Mashruwala was awarded the Faculty of 1000 best poster award at the Rutgers Microbiology Symposium 2015 for his work "Cellular respiration as a trigger for multicellular behavior in *Staphylococcus aureus.*" Ameya is a Ph.D. student in the Microbial Biology Graduate Program, and works in Jeff Boyd's Lab.

Proton Motive Force at The Big Chill, 12/14

The **ASM Student Chapter**, along with the **G. H. Cook Biochemistry and Microbiology Club,** as well as faculty teamed up to run two charity races as **Proton Motive Force (PMF)**. In October, we participated in the Rutgers Against Hunger 5k race, which involved raising monetary donations as well as non-perishable food for the needy. Preshita Gadkari (Häggblom Lab) also won an award in the 20-29 age group for the fastest 5k time. In December, PMF participated in the Big Chill 5K, which donates toys to local children for the holidays. Proton Motive Force looks forward to our next chance to come together and run for a good cause.

Proton Motive Force at the RAH Run for Hunger 10/14

Hosting Speakers: During the 2014-2015 academic year, ASM hosted several speakers. In September, we hosted Dr. Jason Rasgon of Penn State, who gave an exciting seminar about Wolbachia. November, Dr. Nelson Delgado of the New Jersey Department of Public Health. He delivered a well-received talk about Ebola preparedness in New Jersey. During the Spring semester, we hosted Dr. Alyssa MacMillian, also from the Department of Health. Alyssa met with graduate students to talk about career options in addition to giving a seminar on the influenza virus. Wrapping up the semester we hosted Dr. Daniel Gage from the University of Connecticut. He spoke about classical microbiology techniques his lab uses to study rhizobia.

Outreach: Science Saturday/Ag Field Day - February Science Saturday (February 2015)
The ASM student chapter, powered with volunteer grad students, post-docs, and faculty, led the outreach event "Rutgers Science Saturday: Microbes and Human Life". This event was created with the 4H of NJ (Janice McDonnell), and was a microbial boot-camp for grades 5-8. Activities included classroom "Microbial Jeopardy" and laboratory sections on microscopy. We had 30+ students learn about microbiology from the soils, ponds, yogurt, etc. by making slides for observation under the microscope. Student teams that won the "Microbial Jeopardy" rounds were awarded "giant microbes" as toys (we hear that it got very competitive).

TSS Meeting in Miniature: The ASM Student Chapter along with the **Theobald Smith Society** recently held the 2015 Meeting in Miniature and 62nd Selman A. Waksman Honorary Lectureship at Rutgers University. The April 30 event brought together students from Rutgers University, Monmouth University, Princeton University, and the New Jersey Institute of Technology. Over 80 attendees thronged the poster session, a bevy of activity with 43 posters presented by undergraduates, graduates, and post-doctoral scientists. The crowd was treated to seven oral presentations from advanced graduate students and post-docs from both Rutgers and Princeton Universities. The Young Investigator Award was presented to Dr. Alexander Ploss of Princeton University and the Graduate Scholarship recipient was Samantha Lee, a Ph.D. candidate at Rutgers. The highlight of the evening was the Waksman Honorary Lectureship given by Dr. Barry N. Kreiswirth (Director, Public Health Research Institute, Rutgers University – Newark). Dr. Kreiswirth's presentation, "Streptomycin resistance to XDR tuberculosis: Dr. Waksman would not be impressed!", was very well-received. Finally, recognition awards were given to Dr. Andrew Marinucci for his dedication to TSS as a NJ State Science Fair judge, annual program developer, treasurer, and webmaster as well as Joyce Kohler for her service as the membership coordinator and newsletter editor. Dr. Waksman would have been impressed by these Theobald Smith Society activities!

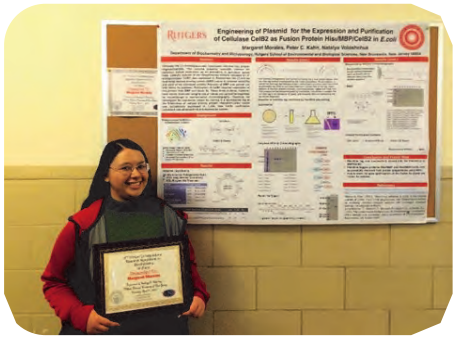
Coffee Mug and T-Shirt Fundraiser: To raise funds for activities, the ASM student chapter is selling Rutgers microbiology themed coffee mugs and T-shirts. A limited number are still available. If you would like to purchase one, please e-mail asmstudents@aesop.rutgers.edu.

Our Undergraduate Students

Awards, Honors and Clubs

L-R: G. Abuhamdeh, L. White, L. Romano, W. Hanson, W. Lam, and C. Vetriani.

Congratulations to the following Biochemistry and Microbiology majors: Ghadeer M. Abuhamdeh, awarded the Theo Van Es Award for service to the major; **Laura Romano**, David H. Strumeyer Award for Academic Excellence in Biochemistry; **William Hanson**, Theodore Chase Award for excellence in Biochemistry and **Wai Lam**, Selman Waksman Award for Academic Excellence in Microbiology.



Margaret Morales

New officers for the G.H. Cook Biochemistry & Microbiology Club

Richard Knappenberger: President;
Stephen Maksymiv: Vice-President; John Tsamutalis: Treasurer; Hemapriya Dhanasekaran; Secretary.

Best wishes to Laura Romano in her new job at Accu Reference Medical Lab!

Undergraduate student **Margaret Morales** (Biochemistry 2015) is the 1st place winner in biochemistry category at the 9th annual undergraduate research symposium, William Paterson University, April 11, 2015. Margaret presented her research project: "Engineering of plasmid for the expression and purification of cellulase, CelB2, as fusion protein His_6/MBP/CelB2 in *E.coli*". Advisor: Natalya Voloshchuk.

G.H. Cook honors theses:

Carly Earle "The regulation of Clp proteases by SrrAB in *Staphylococcus aureus*"; Advisor Jeff Boyd.

Laura Romano "Effects of bisphenol A (BPA) and bisphenol S (BPS) on energy metabolism in Zebrafish embryos (Danio rerio)"; Advisor Lori White.

Bryan D. Ryder "The role of hydration in the formation of insulin amyloid fibrils"; Advisor Peter Kahn.

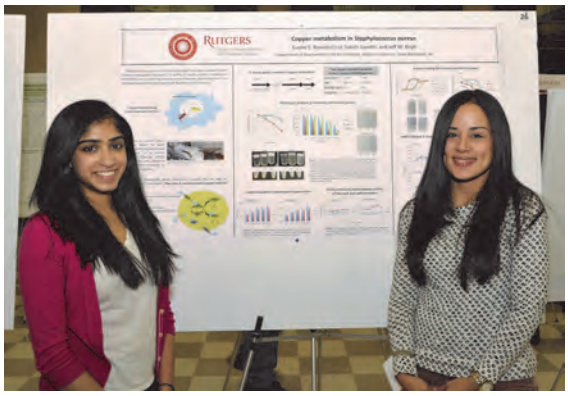
Shira Tziporah Rosenblum "Expression and purification of horse liver alcohol dehydrogenase from *E. coli*"; Advisor Peter Kahn.

Anurita Sadhu defended her honors thesis: "Community Analysis of Pinelands Soils Microbes"; Advisor Max Häggblom.

Adriana Van De Guchte was awarded Honorable mention (4th place award) at the 9th Annual Undergraduate Research Symposium at William Paterson University, April 2015, Poster title- Cellular respiration as a trigger for multicellular behavior in *Staphylococcus aureus.* **Adriana** was also awarded best undergraduate poster award at the TSS meeting, Rutgers, April 2015.

Sakshi Gandhi and **Carly Earle** were awarded Aresty Undergraduate research fellowships. **Sakshi** presented a poster titled "Copper Homeostasis in *Staphylococcus aureus*" at the Aresty undergraduate research symposium and **Carly** presented a poster titled "Regulation of Clp proteases by SrrAB in *Staphylococcus aureus*".

Sakshi Gandhi was awarded honorable mention for her poster "Copper Homeostasis in *Staphylococcus aureus*" at the Aresty Research symposium.



Sakshi Gandhi and Zuelay Rosario-Cruz

Make a Gift to the Department of Biochemistry and Microbiology

Through the years, students in the Department of Biochemistry and Microbiology at Rutgers University School of Environmental and Biological Sciences (SEBS) have been supported in many ways - grants, assistantships, corporate support and fellowships endowed by individuals, just to name a few. Financial support is critical to the ongoing success of our students, and allows them the opportunity to focus fully on their education and research. The next generation of gifted scientists in microbiology and biochemistry need your support. As traditional funding mechanisms become more difficult to secure, we turn to our community of dedicated alumni and friends to support those who will come after them, and continue their legacy of achievement.

There are many ways for you to have an impact. Please consider investing in our students by making a gift to the following funds:

1. **The Douglas E. Eveleigh Endowed Graduate Fellowship:**
   The Douglas E. Eveleigh Endowed Graduate Fellowship is being established to honor Dr. Eveleigh and his decades of service to Rutgers and our students. Our goal is to fully endow this graduate fellowship at $750,000, which will provide a stipend plus full tuition for a first-year student in the Microbial Biology Graduate Program.
2. **Graduate Student Travel Awards**:
   The Stephen M. Cuskey Graduate Student Travel Award
   The Douglas E. Eveleigh Graduate Student Travel Award
   The Stephen M. Cuskey Graduate Student Travel Award honors the memory of the late Dr. Stephen Cuskey ('82).
   The Douglas E. Eveleigh Graduate Student Travel Award honors the legacy of Prof. Doug Eveleigh and his steadfast commitment to students at Rutgers. Both awards are given annually to one or more students travelling to academic or industry conferences related to their research.
3. **Department of Biochemistry and Microbiology Fund**:
   Donations to our department gift fund support research and travel for our undergraduate students in biochemistry and microbiology, graduation awards, the invitation of seminar speakers to our Fermentation Club Seminar series, and other activities of the department.

Make a Gift: http://dbm.rutgers.edu/sheerfun.php

Get on our Mailing List: If you are not receiving your personal copy of the Lipman Log please send us your contact information for email and regular mail to: maguire@aesop.rutgers.edu

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